

### Questions (Some based on questions found on p. 173 and 180 of the textbook)

1. What is the key difference between the models of the atom proposed by Rutherford and Bohr?  
What shortcoming of Rutherford's model does this key difference address?

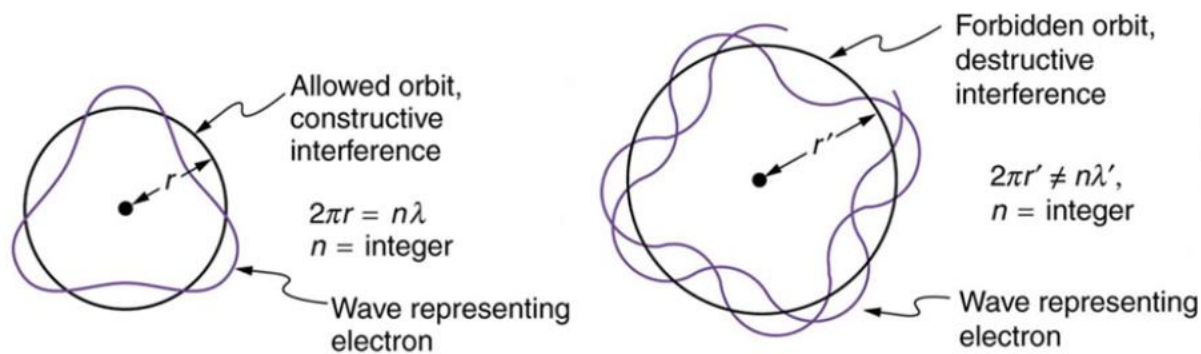
- Although other differences between Rutherford and Bohr's model of the atom, a key difference is that Bohr's model introduces the idea of each atom having (discrete) energy levels, which is not the case with Rutherford.

2. Briefly describe how Bohr's model of the atom justifies the line spectrum of hydrogen.

- Bohr assumed that there is only a specific number of allowable energy levels in an atom. Under this assumption, the electrons in Hydrogen can only emit specific amounts of energy when excited since its electron can only jump from one allowable energy level to another.

3. How do electrons behaving as standing waves explain the quantized energy of the electron in a hydrogen atom?

- Since electrons behave as waves, they can only exist where they interfere constructively, otherwise they would cancel themselves out (see image below). The nature of standing waves limits the number of wavelengths that are allowed to be standing waves (as the wavelengths, and therefore to "jump" from one energy level to next electrons must absorb the specific amount of energy needed to move from one standing wave to another. As such, only a specific amount of energy will be emitted.



- Image taken from <https://opentextbc.ca/physicstestbook2/chapter/the-wave-nature-of-matter-causes-quantization/>.

4. Unfortunately, a classmate of yours had to miss today's class in which orbitals were discussed orbitals. How would you explain to your friend what an orbital is?
  - An orbital can be described as a region around the nucleus where an electron spends 90% of its time.
5. What is the Heisenberg Uncertainty Principle? How did it contradict Bohr's model of the atom?
  - It is impossible to know simultaneously with exact precision both the momentum and position of a particle. In Bohr's model it would be possible to find both the momentum and position simultaneously.
6. What information do solutions to the Schrödinger equation provide?
  - The solutions to the Schrödinger provide a description of the region (orbital) in which an electron is most likely to found as well as provide three integer quantum numbers ( $n, l, m_l$ ) to describe this region.